8.0 SEWAGE TREATMENT

8.0 EVALUATION OF SEWAGE DISPOSAL SITES

The site recommended for the location of the new sewage lagoon is in a natural depression approximately 1600 metres southeast of the existing sewage lagoon facility. The runoff from this site is through a well-vegetated drainage course towards the ocean. This site has been recommended by MACA, DPW, and the Hamlet of Pond Inlet. This pond would be satisfactory for modifying into a natural lagoon.

8.1 Lagoon Treatment

Sewage lagoons or modified lagoons are used to treat over 70% of municipal waste water in the Northwest Territories (Menkal, 1991). The relatively low cost, efficiency, ease of operation and ability to operate in harsh environment accounts for the wide spread use of sewage lagoons as the preferred form of treatment. When properly built and operated lagoons can provide a high level of treatment

Mechanical treatment and maceration systems used to treat municipal wastewaters have not been successful in the NWT. Systems have been abandoned and thus a relative few are in operation at this time. (Heinke, 1990)

Lagoon treatment systems are the primary method of treatment and have been found to perform satisfactorily. The evaluation of treatment methods will be limited to lagoon systems for the community of Pond Inlet.

The level and type of waste water treatment required is dependent on the NWT Water Board guidelines established for the parameters controlling Pond Inlet's sewage disposal methods.

Pond Inlet does not presently have a water license issued by the NWT Water Board. Pond Inlet therefore is not obliged to meet the maximum allowable contaminant limits legally discharged to the environment as stated by the Water Board.(McDonnel, 1992.) It is however advisable that these guidelines be adhered to within this analysis. In the future, the community will likely require a water license and a proper sewage treatment facility such as a lagoon will be a necessity.

The receiving environment is based on the type of water body into which the effluent will enter and the ability of the body of water to assimilate the contaminants present in the discharge stream. The receiving environment for the effluents that would be released in Pond Inlet fit into the Marine category as defined in the Guidelines.

Discharge limits for marine environments are subdivided into two categories depending on the mixing conditions. These mixing conditions are determined by whether the waters are open to the sea or to a bay or fjord. Eclipse Sound fits into the category of "Bay or Fjord"

For the Community of Pond Inlet, the wastewater flow based on a trucked water system fits the category of less than 150 Lpcd (See Table 5) and the effluent will be released in the summer.

From the information provided above, Table 4.1 of the NWT Water Board Guidelines for the Discharge of Treated Municipal Wastewater in the Northwest Territories (1992) the following effluent quality parameters should not be exceeded:

BOD5	100 mg/L
SS	120 mg/L
Phosphorous	No treatment required

Fecal Coliforms need only be of concern in an open well flushed marine Bay or Fjord where the discharge might affect a fishery or water contact recreation.

The existing and the proposed sewage disposal sites are in areas which have not historically been used for recreation. There is however regular foreshore fishing activity for char in the fall and spring seasons and narwhal, beluga, and seal hunting, during the summer. Due to the relatively inactive tides of the northern Baffin region, there is little shellfish population and therefore no known shellfish harvesting activities. The Federal Department of Fisheries and Oceans (DFO) has stated that any improvement to the existing sewage treatment practices of Pond Inlet are welcomed and encouraged.(Young, 1992.) DFO has also asked that they be allowed to review this Design Concept Brief prior to its implementation. This general area was recommended by DPW and MACA and is acceptable to the community. (Anaviapik, 1992). Drainage from this area is generally toward the ocean through non direct well-vegetated courses.

8.1.3 Recommended Lagoon Type

Short and long detention lagoons usually operate with a continuous discharge. The level of treatment provided is governed by the size, or detention time, of the lagoon. Short detention lagoons are defined as having a minimum residence time of three days as defined in the DPW Guidelines. Long detention lagoons are defined as providing a residence time of 60 days.

Storage lagoons are discharged once or twice a year and are sized to provide 365 days storage. Discharge is normally in the spring or fall.

Table 9 provides the anticipated treatment for short detention, long detention and storage lagoons. As noted in the table, Heinke does not provide reduction rates for storage lagoons. The performance of a storage lagoon system is provided as expected effluent quality.

Based on this analysis, a storage lagoon with fall discharge will be required in Pond Inlet to provide the level of treatment to meet Water Board Guidelines.

A controllable effluent discharge system will have to be provided for either sewage Lagoon alternative. The discharge structure recommended for Pond Inlet includes the following:

1. A vertical inlet complete with a screen to retain solids the within the lagoon. The inlet elevation will be set to control the elevation of containment within the pond allowing for sludge accumulation through the design life of the facility.

2. A simple lockable gate valve allowing seasonal discharge of the effluent following the biological treatment of the waste.

3. An outlet pipe constructed through the berm directed toward the well-vegetated drainage path leading to Eclipse Sound.

4. All components of the system vulnerable to freezing will be insulated and have either heat tape or a thaw tube to facilitate thawing.

8.2 MUST & WANT Criteria

Must and want criteria are as described in 7.1 and 7.2 for solid waste disposal sites. They are summarized as follows.

MUST Criteria

1. *Acceptable to Pond Inlet*
2. *Acceptable to DPW and MACA*
3. *Meets Legal Requirements*

WANT Criteria

1. *Minimize Pollution to Receiving Environment (weighting of 10)*
2. *Lowest Capital Cost (Weighting of 10)*
3. *Maximize Local Involvement (weighting of 10)*
4. *Maximize Distance/Location from Existing/Future Development (weighting of 4)*
5. *Minimize Disturbance to Recreation/Fishing Areas (weighting of 6)*

8.3 Alternatives

The only feasible alternatives for the disposal of sewage in Pond Inlet are to modify an existing pond as recommended by MACA, DPW and the Hamlet into a storage lagoon system or to make improvements to the existing facility to provide the containment capacity for the sewage generated by the community of Pond Inlet. Each of these solutions would require a means of discharging the effluent on an annual basis. This discharge should be released after the summer months following the fullest treatment period. Given that the planned development of the Hamlet is towards the existing facility, the option of providing improvements to this system is not an acceptable alternative.

Table 10 analyzes the costs for a berm with an 8 metre crest width while Table 10a analyzes the costs for a berm with a 4 metre crest width. Thurber Engineering, the geotechnical consultants involved in this study, have recommended that for full containment an 8 metre width is required in order to maintain the freeze-back state of the berm. If some exfiltration is acceptable, a narrower berm would satisfy the project. We anticipate that the NWT Water Board will demand a zero exfiltration system for this installation, therefore eliminating the option of constructing the berm narrower than 8 metres.

Table 10a - LAGOON CONSTRUCTION CAPITAL COST ESTIMATE

Projected Waste Volume at Year 2015

66253 (m^3) (See Table 5.)

	UNINSULATED BERM 4 metre Crest							
	(m)	(m)	Area (m^2)	Berm Height	Volume (m^3)	Granular Cost	Discharge Facility	TOTAL
Pond Limits	200	125	25000	4.25	52144.82	$886,462	$15,000	**$901,462**
Lagoon Limits	225	150	33750	3.56	44014.42	$748,245	$15,000	**$763,245**
	250	175	43750	3.11	39443.93	$670,547	$15,000	**$685,547**
	275	200	55000	2.80	36811.20	$625,790	$15,000	**$640,790**

	INSULATED BERM 4 metres Crest								
	(m)	(m)	Area (m^2)	Berm Height	Volume (m^3)	Granular Cost	Insulation Cost	Discharge Facility	TOTAL
Pond Limits	200	125	25000	3.25	32481.77	$552,190	$173,022	$15,000	**$740,212**
Lagoon Limits	225	150	33750	2.56	24933.40	$423,868	$156,371	$15,000	**$595,238**
	250	175	43750	2.11	20488.52	$348,305	$145,194	$15,000	**$508,499**
	275	200	55000	1.80	17685.61	$300,655	$137,566	$15,000	**$453,221**

Estimated Unit Prices:

Granular - $17.00 per placed cubic metre
Insulation - $450 per placed cubic metre based on 50 mm depth
Discharge Pipe, Valve, and Appurtenances - $15,000

Given that Pond Inlet is a maritime settlement and the population takes part in maritime activities, it is impossible not to affect these activities by the practice of effluent discharge. The intent of these proposed facilities is to treat this effluent to a satisfactory level before its discharge to the Sea. SLS 1 is awarded a score of 4 because of its possibility of disruptions caused by the siting.

9.0 RECOMMENDED METHODS OF OPERATION

9.0 RECOMMENDED METHODS OF OPERATION

9.1 Honey Bag Retention Cell - Recommended Method of Operation

Based on a twenty year projected honey bag volume of 161.54 cubic metres, a 2 metre berm height with 3:1 sideslopes and a storage depoth of 1.5 metres, the disposal cell will be approxiamtely 12 metres by 15 metres in size (interior dimensions). Total land requirement will therefore be 40 metres by 43 metres. (See Fig 1).

The estimated volume of granular material required for the construction of the Honey Bag Retention Cell is 1100 cubic metres.

Honey bags are dumped directly into the retention cell from the transport vehicle.

Due to the relatively high solids content of the honey bags, treatment will occur by anaerobic decomposition during the summer months.

Cover material should be sourced from the nearby gravel knolls and stockpiled within the vicinity of the honey bag retention cell for convenient access. This procedure should be carried out midsummer, when the source material is not frozen. A stockpile should be created the summer preceding the required winter cover operation. The volume of fill required for the operational cover is approximately 40 cubic metres. The volume of fill required for the final cover is approximately 100 cubic metres. The cover procedure will be required approximately on the following schedule:

First Operational Cover - April 1994
Second Operational Cover - February 1998
Third Operational Cover - December 2005
Final Cover - December 2005

The total volume of cover material required for the operation of the Honey Bag Retention Cell over the Twenty year Design Life is 220 cubic metres.

In the future it may be possible that this waste will be shipped from the Community. Storage within containers will facilitate removal of this waste from the Community.

Total granular fill requirements for the facility based on a the berm design shown on Figure 5 is 2000 cubic metres, and the requirement for impermeable liner is 1200 square metres.

9.4 Solid Waste Site - Recommended Method of Operation

The presence of ice rich soils in low-lying areas limits disposal of solid wastes to the Area Method of operation. The site should be worked from the high side of the defined area working down the slope. (See Fig 3).

Solid waste is dumped on the working face from the collection vehicle and periodically spread and compacted with a bulldozer. Once the refuse accumulates to a depth of approximately 750 mm, a 200 mm layer of cover material is spread and compacted. The slope is then ready to receive the next and final 750 mm deep layer of waste. Following the placement of this layer of waste, a 500 mm deep layer of granular cover material should be placed and graded to allow drainage off of the fill.

As the working face advances, a final capping layer of fill 500 mm deep is placed to provide a finished surface. It may be desirable to use less porous fill material for the final cover to reduce the infiltration of water. A minimum slope of 5% is recommended if the final capping layer is of a high porosity or 2 % if the cover material is of a low porosity.

Based on a 200 metre working face, the working slope will be approximately 10 m wide including cover material with a horizontal rate of advance of approximately 11 metres per year.

Cover material should be sourced from the nearby gravel knolls and stockpiled within the vicinity of the solid waste disposal site for convenient access. This procedure should be carried our midsummer, when the source material is not frozen. A stockpile should be created annually of approximately 1500 cubic metres. This volume should satisfy the cover requirements for the annual generation of waste. The cover material required for the operation of the facility over the twenty year design life is 30,400 cubic metres.

10.0 REMEDIATION OF EXISTING FACILITIES

10.0 REMEDIATION OF EXISTING FACILITIES

Once the new solid waste site and sewage lagoon have been commissioned, the existing sites should be closed and remediated. The estimated cost for this work is $124,850. (See Table 12).

The initial procedures recommended for the remediation of the existing facilities are as follows:

10.1 Sewage Lagoon

Once the new sewage lagoon is constructed and operational, the existing sewage lagoon should be drained. Draining should occur following a summer season when the sewage has been allowed to decompose naturally. The sludge then should be allowed to decompose aerobically. This decomposition will only be possible if the sludge is turned over periodically. As a general rule, one revolution of the sludge should be adequate on an annual basis. It is advisable that the lagoon be fenced during this remediation period. The sludge should be tested for fecal coliform content on an annual basis to judge the effectiveness of the aerobic decomposition. Future development of this area is not recommended without the approval of a recognized Health Officer.

The bulk of the input required for the remediation of this facility is labour and time. All that is required in terms of materials is 250 metres of chain link fencing.

Once the Health officer has been satisfied that the facility is acceptable, the fence, berm, and outlet culvert may be removed. The culvert should be disposed of at the new bulky waste disposal pad and the berm material should be disposed of in the solid waste site in the manner of solid waste, not cover material. The fence material may be reused as the Community requires.

Cost estimates for the remediation are given in Table 12 of this document.

10.3 Honey Bag Storage Facility

The recommended remediation practice for existing honey bag storage pits is to place a final cover of 500 mm of granular material over the existing facility. The area previously used for the disposal of Honey Bags should not be included in areas for future development.

An estimate of the granular material required to complete the remediation of this facility as detailed above is 150 cubic metres.

Cost estimates for the remediation are given in Table 12 of this document.

10.4 Solid Waste Disposal Site

Initial preparation for the remediation of the Solid Waste Disposal Site should include an inspection of the site to determine if there are any potentially hazardous materials such as full barrels of unidentifiable waste. If hazardous materials are identified, the Pollution Control Division of the GNWT should be contacted for directions on disposal methods.

Following the initial survey of the contents of the Solid Waste Disposal Site, the recommended procedure for the remediation of the existing solid waste site is to carry out a final compaction and incineration routine and the placement of a cover layer of 500 mm deep of well graded granular material over the refuse. If possible, low permeability cover material should be used to reduce the infiltration of water. The cover material should be graded to a minimum slope of 2% if a relatively impermeable material is used for the cap or a minimum of 5% if a more porous granular material is used.

It is recommended that a shallow swale be constructed around the perimeter of the new site which will intercept run-off and leachates in order to assist with the monitoring of water quality from the dump site after closure. This swale will also reduce the amount of run-off migrating through the waste site from overland flow.

Given that the dimensions of the existing solid waste disposal area are approximately 70 metres by 100 metres and the recommended final cover layer is 500 mm, the estimated granular material required to complete the remediation of this facility as detailed above is 3500 cubic metres.

Cost estimates for the remediation are given in Table 12 of this document.

Table 12 - SOLID WAS[illegible] SITE REMEDIATION CAPITAL COST ESTIMATE

	GRAN			MEDIATION
	(m)	(m)	Area (m^2)	TOTAL
Honey Bag Retention Cell	20	15	300	$2,550.00
Bulky Waste Disposal Pad	100	40	4000	$13,600.00
Solid Waste Disposal Site	70	100	7000	$59,500.00

CHAIN LINK FENCING ABOUT SEWAGE LAGOON		
Required Length (m)	Installed Unit Cost ($/m)	TOTAL VALUE ($)
250	80	$20,000

EMENTS
ASTE DISPOSAL PAD

		ited ite	Total Estimated Cost
Manhours		25	$10,000
Loader	80	120	$9,600
Truck	160	$60	$9,600
			$29,200.00

TOTAL ESTIMATED REMEDIATION COSTS FOR THE EXISTING FACILITY	$124,850.00

Estimated Unit Prices:
Granular - $17.00 per placed cubic metre

11.0 CONCLUSIONS AND RECOMMENDATIONS

11.0 RECOMMENDATIONS AND CONCLUSIONS

1. Two potential solid waste disposal sites have been identified. Based on the results of the evaluation of these sites, it is recommended that a new solid waste disposal site be located at the site identified as SWS1 on the accompanying location map.

2. The disposal site should be constructed and operated as a modified landfill. The area method of disposal should be used.

3. The solid waste disposal site should include a seepage pit for disposal of honey bags, a waste oil retention cell, and a segregated area for the disposal of bulky metal wastes.

4. The capital cost of constructing a solid waste disposal site at SWS1 is estimated to be $216,320.

5. One potential sewage lagoon site was identified. SLS1, a modified pond is acceptable for the conversion into a sewage lagoon, but will require modifications as detailed in Thurber's report on the subject.

6. It is a recommended that a storage lagoon be constructed which will provide 365 days storage of sewage at the design life of the facility to meet the recommendations of the NWT Water Board Guidelines for the Discharge of Treated Municipal Wastewater. The facility should be discharged in the fall of each year to provide maximum available treatment for the sewage.

7. The capital cost of constructing the lagoon has been estimated to be between $573,000 and $900,000 depending on the configuration. The variance is due primarily to the varying granular quantities required for a shallow bermed system with a large plan area versus a higher berm with a smaller plan area. It is recommended based on the great variance in cost to plan for a shallow bermed system with a large plan area.

8. Community water consumption, solid waste and sewage disposal volumes should be recorded on a daily basis to provide a basis for future planning and design of municipal services.

9. Raw sewage should be sampled and analyzed to provide a basis for the design of the sewage treatment facility.

12.0 BIBLIOGRAPHY

12.0 BIBLIOGRAPHY

Anaviapik, Jake, 1992. Senior Administrative Officer of the Hamlet of Pond Inlet. Personal Communication.

Armstrong, Rick, 1992. GNWT ,MACA Baffin Region. Personal Communication.

Buchanan, W.D., 1978. Pond Inlet - Water Supply & Waste Disposal. Prepared by W.D. Buchanan Limited.

Davies, Bill, 1992. GNWT Department of Transportation Arctic Airports Division. Personal Communication.

Dean, Burt, 1992. GNWT Department of Renewable Resources. Personal communication.

Fowler, Pat, 1992. Baffin Regional Health Board in Iqaluit. Personal communication.
Grainge, Nov. 8, 1976. Pond Inlet - Water Supplies & Waste Disposal. Prepared by the Federal Department of Health and Welfare.

Heinke, G., Wong, J., 1990. Pond Inlet - An Update of the Status of Solid Waste Management, prepared for the GNWT department of Municipal and Community Affairs.

Jessiman, David, 1990. Pond Inlet - Northern Waters Act Inspection Report. Prepared by the Federal Department of Indian and Northern Affairs.

McDonnell, Kevin, 1992. Indian and Northern Affairs (DIAND) Canada, Water Resources Division. Personal Communication.

Stephen, B. A. 1991. Pond Inlet - Water Supply & Sanitation Sites Inspection Report, prepared by the Baffin Regional Health Board.

Yeung, Wing, 1990. Pond Inlet - Sewage/Solid Waste Report. Prepared by the DPW Baffin Region.

Young, Tim, 1992. Federal Department of Fisheries and Oceans, Iqaluit district office. Personal communication.

APPENDIX 1

PROPOSED NEW SEWAGE LAGOON AND SOLID WASTE SITE POND INLET, N.T. GEOTECHNICAL EVALUATION

Report Submitted

to

FERGUSON SIMEK CLARK

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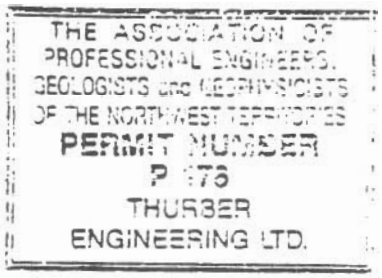

October 15, 1992
File No. 17-947-20

R.C. Cook, P.Eng.
Project Engineer

THURBER

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17\947-20RP

SECTION 1

INTRODUCTION

1.1 General

This report presents the results of a geotechnical evaluation in connection with the relocation, design and construction of proposed new sewage and solid waste disposal facilities in Pond Inlet, N.T.

The scope of work was outlined in our proposal dated August 28, 1992 which was submitted to Mr. Kevin Hodgins, P.Eng. of Ferguson Simek Clark. Authorization to proceed with the work was received verbally from Mr. Hodgins on September 2, 1992.

The use of this report is subject to the Statement of General Conditions which is included at the end of the text of this report. It is considered essential that these conditions be followed for proper use and interpretation of this report.

1.2 Proposed Development

The proposed development will consist of relocating the existing sewage lagoon to a new site which is presently a natural depression with varying water levels, dependent on the time of year. This location has been selected by the community. The community has also chosen a solid waste site approximately 300 metres beyond the proposed lagoon site, however, due to its location in a ravine with a stream running through it, this site is unacceptable to both MACA and DPW. A more suitable solid waste site will be chosen in the vicinity of the sewage lagoon. Both facilities will be designed for a 20 year life expectancy.

The Department of Public Works is currently designing an access road to the new sites which are approximately 1.6 km northeast of the existing waste sites.

The overall project schedule calls for construction to be completed by October 1994.

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SECTION 2

METHOD OF INVESTIGATION

2.1 Review Geotechnical Data

Available stereo air photographs of the proposed sewage lagoon site were reviewed in the MACA office in Iqualuit by Mr. Rob Cook. P.Eng. of Thurber Engineering Ltd. while on route to Pond Inlet on September 10, 1992. The surrounding area was also examined on the air photos for potential borrow sources.

Since air photo coverage of the area did not extend to the ravine proposed for solid waste disposal, this area could not be examined prior to our site visit.

Numerous geotechnical reports on Pond Inlet prepared by various Consultants were also available for review in MACA's Iqaluit office. Relevant portions of these reports were reviewed in detail; however, previous work in the community has concentrated on development of the water reservoir, various borrow sources along the reservoir road, and sites within the present community development.

Extensive work has been completed on terrain analysis based on air photo interpretation, however, the limits of these studies do not extend as far as the proposed site. All the information, however, was used to form the basis of our understanding of the ground conditions in the Pond Inlet area and was extrapolated to some degree to shed some light on conditions at the new site.

2.2 Field Investigation

A site inspection was carried out on September 11, 1992 by Mr. Cook. P.Eng. of Thurber Engineering and Mr. Kevin Hodgins, P.Eng. of Ferguson Simek Clark (FSC). The site was identified to us by Mr. John Mores, resident surveyor for DPW, who showed us the proposed road alignment as well as the proposed lagoon and solid waste sites. Mr. Mores also identified several possible granular borrow sources located along the proposed road alignment.

Surface conditions at the proposed lagoon were examined and photographs were taken. It was not possible to determine the maximum depth of the pond.

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SECTION 3

SITE CONDITIONS

3.1 Surface Conditions

The proposed sewage lagoon site is located on a relatively flat area between a ravine and an elevated rocky ridge. The ground surface throughout the area is sparsely vegetated tundra with numerous cobbles and boulders protruding from the surface.

The existing pond appears to be a relatively shallow depression with low bank. Although we do not presently know the required containment volume our observations indicate that berms will be required to some degree to develop significant further containment. It is understood that a topographic survey in the pond area has been completed by others.

It was apparent that the pond level had been slightly higher recently, and that the surface area was much larger at that time.

Drainage from the pond is presently through a well vegetated course which runs relatively steeply from the pond northward into Eclipse Sound.

The terrain also slopes gently down to the south of the pond. The ravine is to the east, approximately 200 m, with a small knoll in between. A sketch of the approximate locations of these surface features is presented on Drawing No. 1 in Appendix A.

3.2 Subsurface Conditions

Detailed information on subsurface conditions near the existing pond could not be determined utilizing a local 950 loader due to frozen and bouldery conditions. It is assumed, based on previous air photo interpretations, that subsurface soils will consist of granular materials ranging in consistency from coarse bouldery till to silty sand and gravel.

Permafrost conditions exist throughout the area with active layer depths ranging from virtually 0 m in poorly drained areas near the pond to over 1.0 m in well drained granular areas at the time of our investigation. It is not expected that the proposed development will have permanent detrimental effects on the permafrost regime. In fact, we will rely partially on aggrading permafrost to facilitate lagoon containment.

SECTION 4

GEOTECHNICAL EVALUATION AND RECOMMENDATIONS

4.1 General

Results of our investigation indicate that the proposed sewage disposal site is suitable with respect to geotechnical conditions. It is expected that the perimeter of the existing pond will have to be raised in order to provide adequate containment volume. Depending on the containment volume required it may be a more efficient use of building material to simply construct a perimeter berm that will create a deeper pond with smaller surface area. Part of the existing pond would be cut off by this procedure.

Also, it is understood that a suitable solid waste disposal site has been identified by FSC in the vicinity of the sewage lagoon in an isolated natural depression near the head of the noted ravine.

Detailed recommendations are included in the following sections.

4.2 Sewage Lagoon Berm Construction

Berm construction will be required, on the north side of the pond near the existing discharge point to increase retention time and containment volume. Depending on the expected volume of waste and the rate of dumping additional berms may be required around the entire perimeter.

Where berms are required, it is recommended that the entire area below the berms be scarified to a depth of approximately 150 to 200 mm and that all organic material be removed. The first lift of fill material should then be placed and compacted such that the combined thickness of scarified soil and loose fill does not exceed 0.5 m in thickness. Subsequent layers of fill should be placed and compacted in lifts not exceeding 0.3 m in compacted thickness. A minimum of 8 passes with a large dozer should be used for compaction if a vibratory roller is not available.

All fill for berm construction should consist of unfrozen, inorganic soil. Boulders in excess of 300 mm in diameter should be avoided in the fill. The material encountered in the test pits on the ridge adjacent to the pond appears to be suitable for this purpose.

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As discussed previously, several potential borrow areas have been identified by DPW along the proposed road alignment. As well, a relatively large ridge deposit was investigated by test pitting during our site visit. It appears that adequate volumes of suitable material can be obtained for berm construction from this ridge deposit. Our test pits, however, were only able to expose the upper 0.75 to 1.0 m of this material.

4.6 Solid Waste Site

It is understood that FSC have identified a potential solid waste site south of the proposed lagoon site in a natural depression at the head of the ravine. The depression is understood to be isolated from the main ravine and therefore should not be subject to surface flow during spring run-off. This general approach appears feasible provided that adequate volume and area are provided for sorting, storage and cover.

Based on our observation of the surface conditions and local geology, it is also recommended that the solid waste site could be developed by making use of one of the borrow pits developed for this project. In other words a borrow pit would be developed in such a way that solid waste can be placed, sorted and covered within the depleted pit. One possible location would be part way down the ridge slope towards the lagoon site. This location would be near the lagoon, near the proposed road alignment, not near any drainage courses and protected from view of the community by the ridge.

Presumably, enough material will be excavated from this source for both berm and road construction to provide the required storage space for the anticipated solid and bulky waste.

4.7 Closure

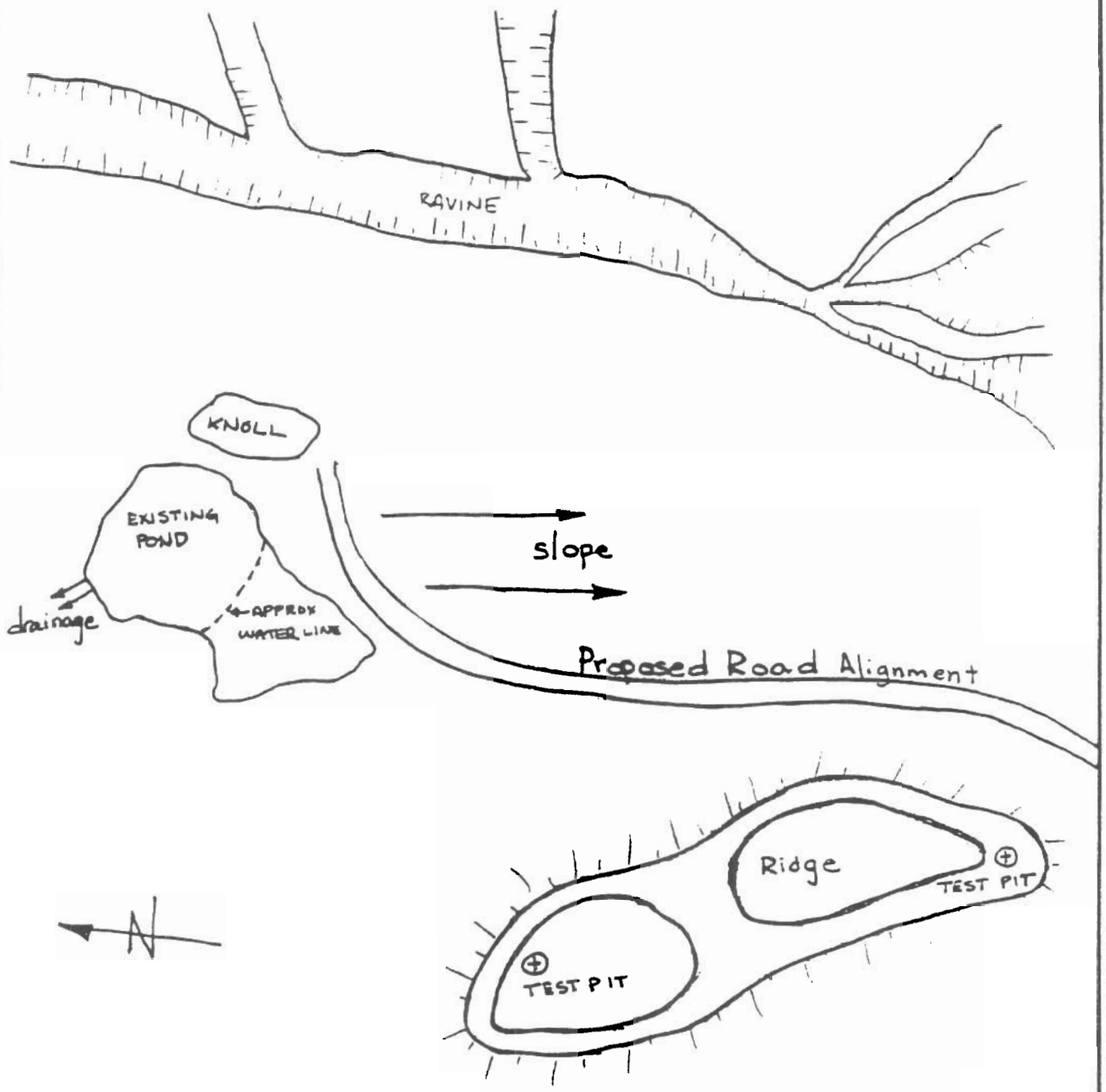
This report has been prepared on the basis of air photo interpretation, shallow test pits, observations of surface conditions and our previous experience with lagoon construction in permafrost regions.

We would be pleased to review our recommendations in light of any further subsurface information that may become available either prior to or during construction.

THURBER

APPENDIX A

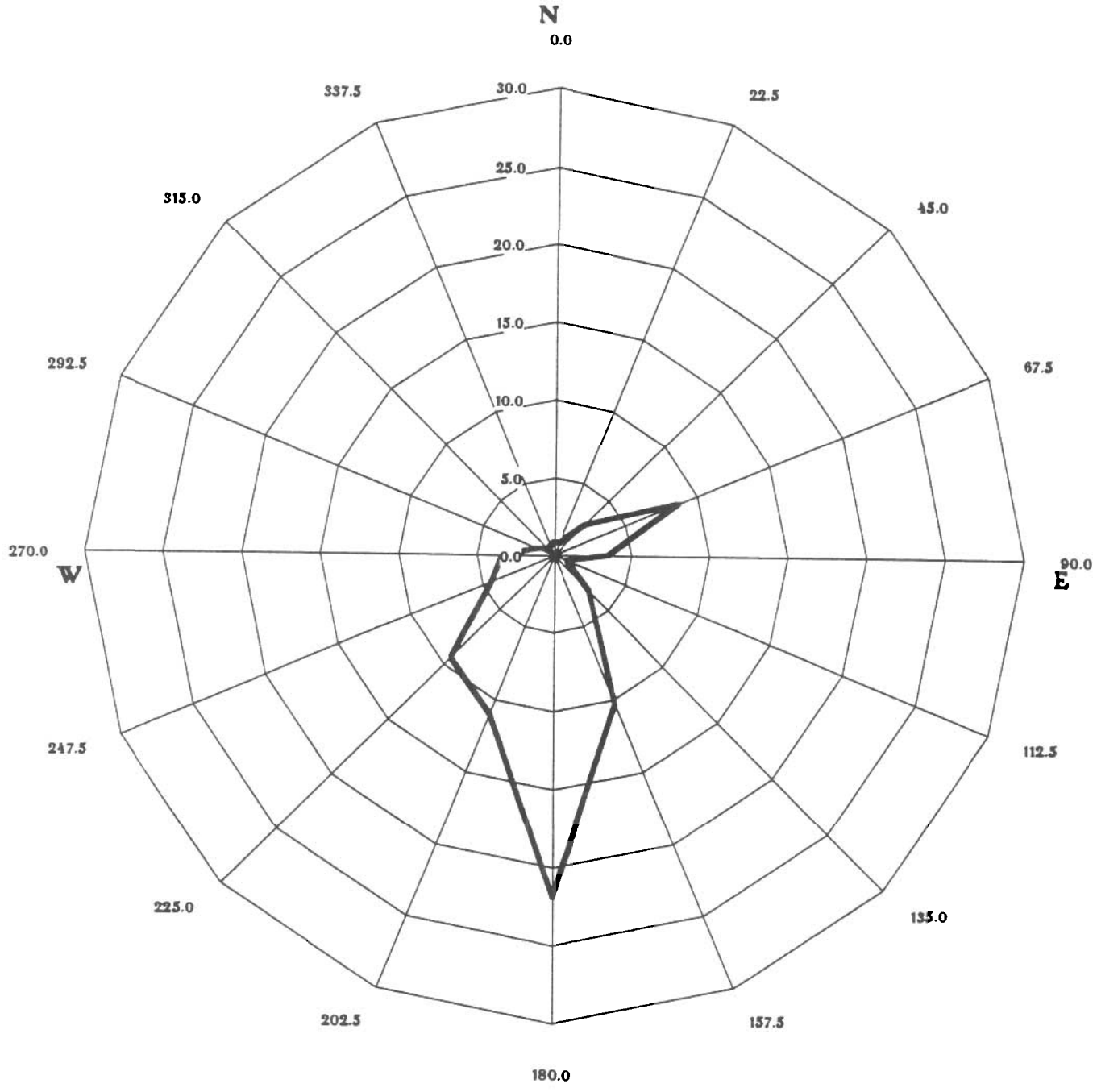
DRAWING NO. 1



DESIGNED	POND INLET WASTE DISPOSAL SITE	THURBER
DRAWN RCC		
DATE 24/09/92	SITE SURFICIAL FEATURES	DRAWING NO 1
APPROVED		
SCALE NTS		

APPENDIX 2

Wind Frequency
(percent)

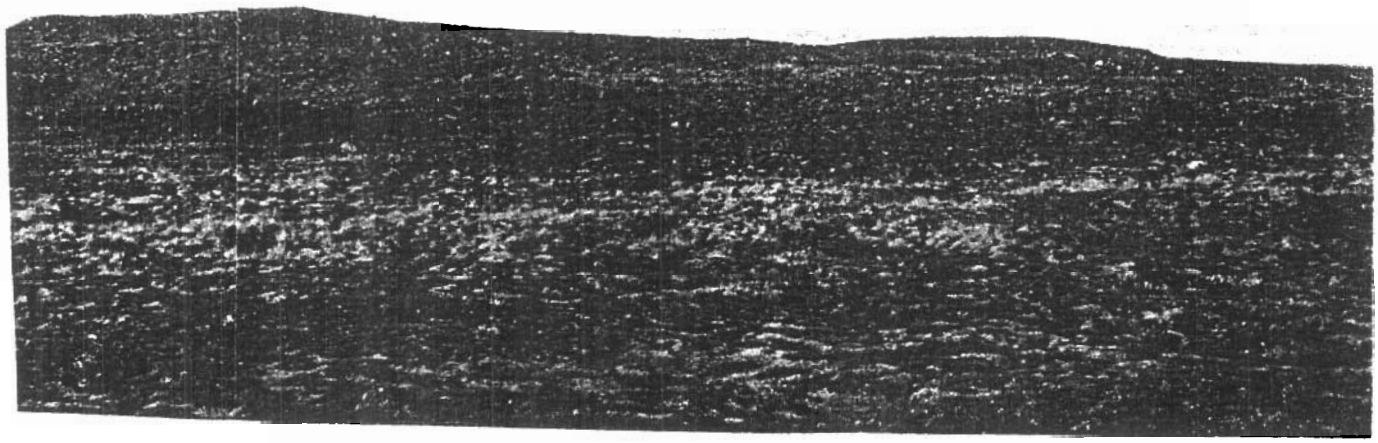


Ferguson
Simek
Clark

APPENDIX 3

Existing Solid Waste Disposal Site

Existing Sewage Lagoon Site



Proposed Solid Waste Disposal Site

Proposed Sewage Lagoon Site